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ISCHEMIC HEART DISEASE AND COSMIC RADIATION

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ISCHEMIC HEART DISEASE AND COSMIC RADIATION

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Heart and vascular disease is one of the most important reasons for illness / 19* in the population, invalidization and mortality. A leading role in this belongs to coronary arteriosclerosis (coronary, ischemic and arteriosclerotic heart disease).

Certain authors note that in many countries diseases of the heart and arteries are, today, the cause of death of more than one-third of the male population. It is suggested that in coming years mortality from these diseases will increase. This situation can be explained by the absence, up to this time, of convincing data which explained the etiology and pathogenesis of these diseases, and, consequently, adequately effective methods of preventing and treating them.

Elements of the environment have an exceptionally large influence on the many variations with respect to the significance and reliability of etiological and pathogenetic factors of ischemic heart disease. Observations which established a certain dependence of many biological phenomena on the planet on the activity of the Sun turned out to be interesting. Here one cannot fail to note the corresponding work of one of the founders of heliobiology, A. L. Chizhevskiy. He established, specifically, the relationship between solar activity and cardiovascular catastrophes.

In recent years materials have appeared concerning the dependence of many functions and reactions of the organism on the character of solar radiation. This indicates that such components of the environment as corpuscular and wave factors, as well as energy fields should be studied applicable to both arteriosclerosis and ischemic heart disease.

In the literature available to us we did not encounter any information concerning the influence of cosmic radiation on the conditions of patients with

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*Numbers in the margin indicate pagination in the foreign text.

ischemic heart disease. However, bearing in mind the probability of indirect effects on the submolecular bioenergetic structures of the organism with respect to fluxes of cosmic rays, and assuming the possibility of the appearance of corresponding effects causing changes in the functions of tissues, organs, and systems of man, we attempted to explain the reality of this hypothesis.

For comparison with "medical" indices, we used data concerning variations in the nucleonic component of cosmic rays recorded directly on the surface of the Earth.

The relatively large flux of cosmic radiation continuously striking our planet varies with respect to its nature and force. This radiation can be divided into types: electromagnetic and corpuscular. Dependent upon the force, each type, in its turn, can be divided into two classes: galactic and solar. Each of these types of radiation has its own capacity to penetrate through the Earth's atmosphere, and, additionally, has a different effect on biological objects.

Fluxes of energy are distributed throughout the entire electromagnetic radiation spectrum of the Sun. In the terrestrial atmosphere there are "windows" for the passage of this radiation. Such a "window" exists for a flux having a wavelength ranging from several mm to approximately 5 m (the low frequency region of the radio portion of the spectrum). The infrared region of the spectrum, with respect to low frequencies, is entirely absorbed up to waves having a length of 10-15 μ. There is also a "window" in the frequency range of visible radiation. Then there is a band of absorption in the range of "soft ultraviolet" and thence — to the end of the spectrum (the region of x-rays and shorter rays are entirely absorbed.

If one views the question from the viewpoint of the transmission of energy by a flux of radiation in any particular region of the spectrum, then the zone of visible radiation includes within itself energy which, to a significant extent, is in excess of the energy transmitted by electromagnetic radiation in other frequency ranges.

In differentiation from the wave radiation of the Sun, electromagnetic radiation of galactic origin is many times weaker, and when explaining the question of cosmic-biological (terrestrial) links, it can be ignored.

We shall now examine a flux of corpuscular radiation generated by the Sun. When comparing the amount of energy included in this flux with the amount of energy of the electromagnetic radiation of the Sun, the first is several orders greater than the second. However in the given case one must bear in mind one significant factor: primary nucleons having an energy less than 10^9 electron volts, being transformed in the Earth's atmosphere to secondary particles, do not reach the surface of the planet, and neither do the secondary particles absorbed in the atmosphere. For a corpuscular flux having an energy level up to 1 Gev, there is no "window" in the atmosphere. When considering this it is also necessary to take into account the fact that the magnetic field of the Earth, being a natural spectrometer, additionally screens the Earth from the flux of charged particles. Thus, for example, the surface of the Earth in the region of its equator can be reached only by particles having an energy level in excess of 15 Gev, but such particles are generated on the Sun only in certain rare flares.

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Matters are otherwise with the corpuscular flux of galactic origin. The particles of this flux include energy comparable to the energy of the radiant flux. Thus, just as in the case of solar cosmic rays, galactic cosmic rays having an energy level less than 1 Gev do not reach the surface of the Earth — neither primary nucleons nor secondary particles. But the basic flux of galactic cosmic rays include particles having an energy level greater than 10 Gev. Consequently, the secondary particles which are formed by them reach the surface of the Earth from its biosphere.

We shall evaluate the energy of the radiant flux (maximal in the spectrum of electromagnetic radiation) and the flux of cosmic rays whose secondary particles reach the Earth. As one can see from Figure 1, the flux of radiant energy in the maximum is $2 \times 10_{-12}$ watt/m^2/hertz. If one takes into account the fact that 1 watt/m^2/hertz is equal to 6.24×10^8 ev/m^2, then $2 \times 10_{-12}$ watt/m^2/hertz is equal to 1.2×10^7 ev/m^2. Taking into account the range of

frequencies, we find that the energy of the electromagnetic flux (1 e.m.) is approximately 10^{13} ev/sec. Page One Title

One can also calculate the flux of the energy included in the cosmic rays. This energy is approximately 10^{14} ev/sec. Page Title

When comparing the energy of electromagnetic cosmic rays one can see that the flux of energy of cosmic rays is greater than the flux of radiant energy of the Sun. The energy striking the Earth as the result of other types of radiation is several orders smaller in comparison with the energy of cosmic rays and the energy of electromagnetic radiation of the Sun, and it can be ignored.

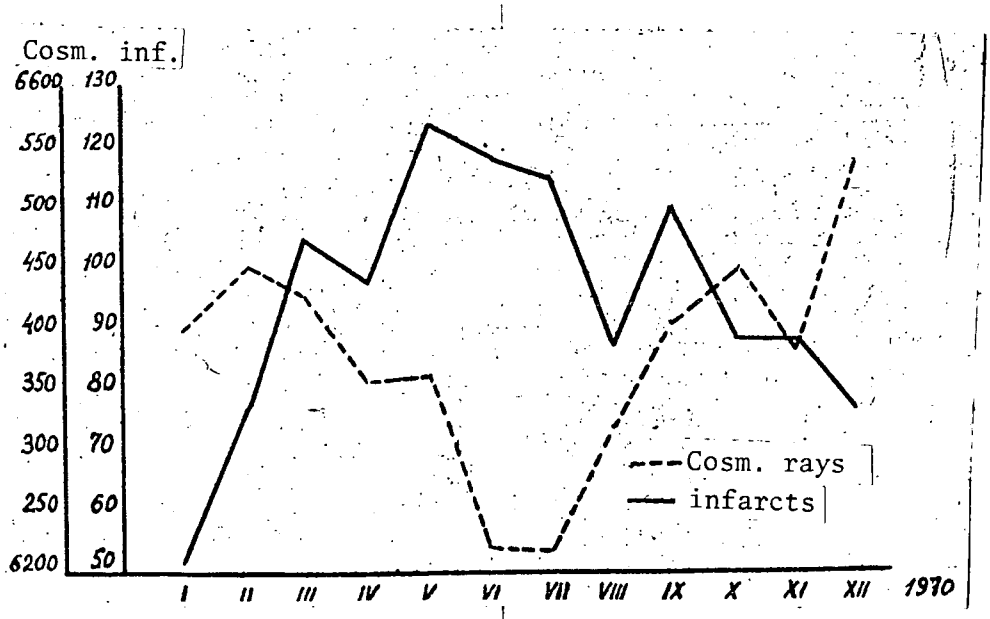

Figure 1.

We shall now examine the possible effect of radiant radiation and the nucleon component of cosmic radiation on the human organism. The nucleon component was selected by us because it includes within itself a large part of all the energy of cosmic rays (more than 5×10^{13} ev) on the surface of the Earth and has a large effective intersection for nuclear interaction with light nuclei (nuclei of hydrogen, oxygen, carbon dioxide, nitrogen, etc.). Since the human organism consists primarily of elements having light nuclei, nucleons are extremely effective and react with them at the entire depth. The radiant flux

in an ionizing and nuclear regard produces an insignificantly small contribution. Therefore, in this aspect the change in the nucleon component in time will, in a determinant fashion alter the ion composition throughout the entire depth of the organism.

This is why we have dwelt on a comparison of the "medical" indices namely with the nucleonic (neutron) component of cosmic radiation.

Indices reflecting the neuro-vascular reaction in patients with ischemic heart disease were compared with the quantitative characteristic of this component (according to the number of ambulance trips from the medical first aid station in connection with the appearance of myocardial infarcts, and, for comparison, cranial insults). A comparison was also made of indices of mortality from myocardial infarct (according to death certificates). During a comparison of the number of ambulance trips from the aid station in the city of Alma-Ata for the above listed cardiovascular catastrophes (with respect to infarcts — 1970 and 1971, with respect to insults — 1970) with the magnitude of the index of the nucleonic component, the following was revealed. /21

In 1970 the largest number of trips with the established diagnosis of myocardial infarct were made in May, June and July — respectively, 26, 26 and 16% above the average yearly index. The least number of these catastrophes occurred in December, January and February — lower than the average yearly index, respectively, by 16, 47 and 16%.

In 1971 a similar picture was observed: the greatest number of ambulance trips were recorded in April (greater than the yearly average by 43%), May (by 31%), and June (by 43%). The least number of ambulance trips was noted in August, November, December and January (respectively, by 23, 12, 45 and 33% less than the average yearly index).

Figure 1 shows the results of comparing the average monthly indices of the number of infarcts with the magnitude of the nucleonic component for 1970. This comparison revealed an inverse correlation with a moderately close relationship ($r = -0.55$). Following conversion of the series by the method of smoothing the averages, the relationship turned out to be more tightly linked ($r = -0.83$).

The picture of seasonal appearance of insults became quite apparent. The greatest number of these was recorded in March, April, May and June with a high peak in May (98% higher than the average yearly index), and also in November and December. Comparison of the number of insults (average monthly indices) with the magnitude of the nucleonic component, following smoothing of averages and movement of the index of insults by 2 months back showed a positive correlation with a high closeness of relationship (r = +0.93).

In examining the data for mortality of urban inhabitants, (the necessary data were available only for 1961 and 1970), we also noted an uneven advance of mortality for myocardial infarct in the course of the year. Thus, in 1961 the largest number of mortalities (average monthly indices) was in March, April and May — respectively higher than the average yearly index by 19, 22 and 61%, and also in October (by 19%). In 1970 these indices exceeded the average yearly indices in March, by 22%, in May, by 26%, in October, by 33% and in November by 22%.

During a comparison of the average monthly indices of mortality from myocardial infarct with the corresponding magnitudes of the nucleonic component for 1961 (following transformation of a series by smoothing averages) a direct correlation was established with an average degree of closeness of relationship (r = +0.58). Comparing the similar indices for 1970 revealed a correlation, as well, with an average degree of closeness of relationship (r = + 0.46). This coefficient of correlation turned out to be significantly higher (r = +0.73) during a comparison of series with a shift of the indices for mortality by 2 months back).

A comparison of the average yearly indices of mortality from myocardial infarct with the same indices of the level of the nucleonic component for the period from 1959 through 1970 (Figure 2) also revealed a quite close positive relationship with the coefficient of correlation, equal to +0.73 (up to smoothing of the averages) and +0.83 (following smoothing). /22

During a comparison of the value of the coefficient of correlation with the magnitude of its mean error, in all of the cited indices this coefficient turned out to be adequately reliable. It exceeded its mean error 3 to 4 times.

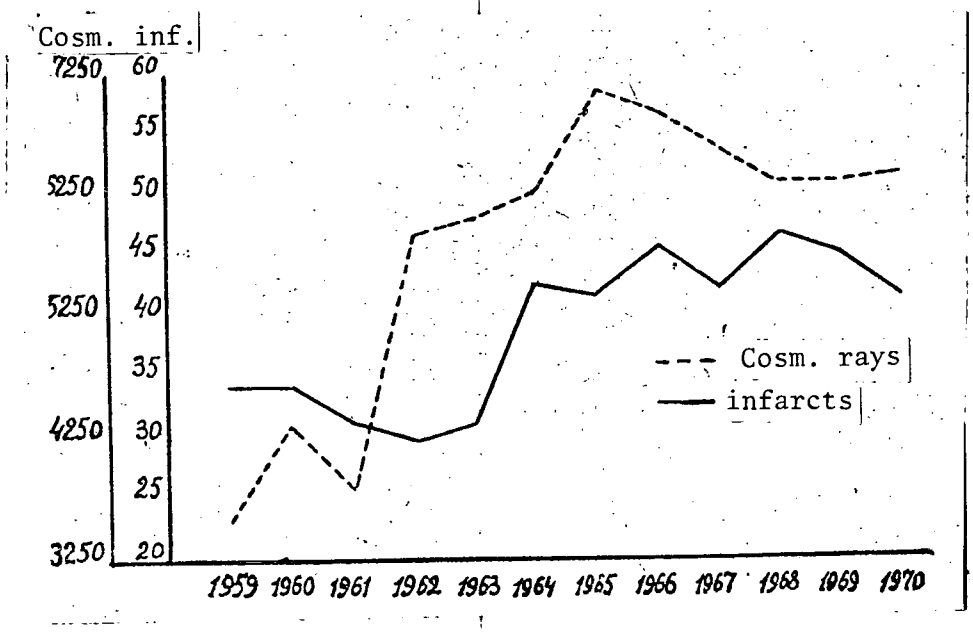

Figure 2.

In connection with our observations one can come to the following conclusions:

1. An analysis of the appearance of the cardiovascular catastrophes (in the given case myocardial infarct and medullary insult) revealed a certain seasonal principle. These data confirm similar results obtained by other investigators.

2. A comparison of the indices characterizing the number of cardiovascular catastrophes (in the given case myocardial infarct), with the indices of cosmic radiation corresponding in time (according to the magnitude of the nucleonic component) revealed a certain adequately reliable correlation. With regard to this, during a study of cosmic-terrestrial links one can use indices characterizing the magnitude of the nucleonic (neutron) component.

3. The cited data provide a basis for assuming a dependency of the frequency of cardiovascular catastrophes (the appearance of myocardial infarcts, medullary insults, mortality from myocardial infarct) on the magnitude of the energy of cosmic rays.

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For explaining a large number of appearances in relation to the cited analysis of these questions further, expanded investigations are required.

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